SECTION 4- HEAD ASSEMBLY

4.1 Head Assembly Description and Features

The head assembly includes the head casting, skull cap, internal mounting plate, instrumentation mounting brackets, instrumentation, and skins. The internal ballast weights have been pre-installed within the skull cavity to adjust for the CG location and overall mass of the assembly to meet human requirements. The head is instrumented with three uniaxial accelerometers located at the CG of the head, three sets of paired uniaxial accelerometers located along the perimeter of the skull cavity, and a dual axis tilt sensor. The head has been specifically designed for use with the Endevco accelerometers model number 7264C-2KT so that the CG of the head of THOR would approximately match the human location.

The array of accelerometers are oriented to provide the data required to reproduce the head kinematics. The accelerometers are arranged in the following manner: CG (acceleration measurement in the X,Y, & Z axes), top (acceleration measurement in the X & Y axes), rear (acceleration measurement in the Y & Z axes), and side (acceleration measurement in the X & Z axes). The distance from the point where the three axes of the CG accelerometers intersect to the point where the axes of the paired accelerometers intersect for each of the three sets of accelerometers is as follows: CG to the rear accelerometers = 2.00 inches, CG to the side accelerometers = 1.90 inches, and CG to the top accelerometers = 2.75 inches.

The tilt sensor is used to measure the angular orientation of the head about the X and Y axes in a static (pre- or post-test) mode. **Figure 4.1** shows a drawing of the THOR head assembly.

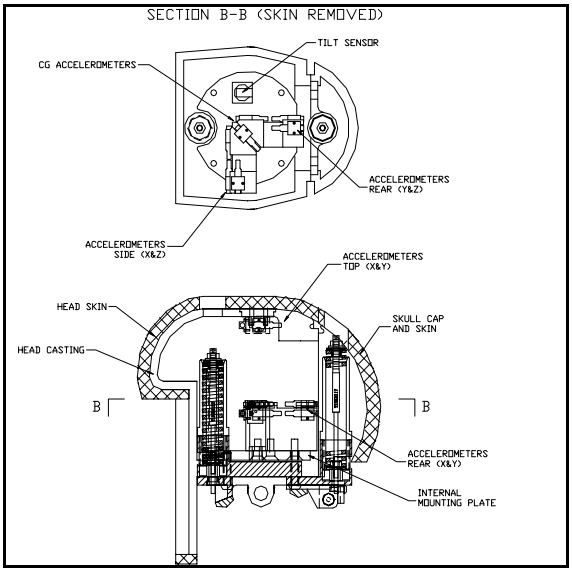

Figure 4.1- Head Assembly

4.2 Assembling the Head

4.2.1 Parts List

The parts list as well as all quantities for the head assembly are listed in Appendix I - Bill of Materials under the Head subsection. Refer to drawing T1HDM000 in the THOR drawing set for a detailed mechanical assembly drawing. **Figure 4.2** is a photograph of the exploded head assembly. The fasteners are not included in the photograph to better display the main parts of the head assembly.

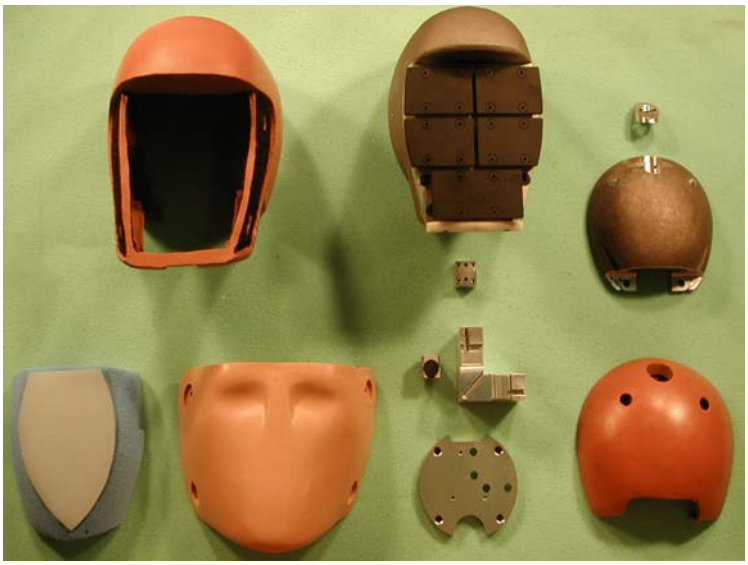

Figure 4.2- Explode head assembly

4.2.2 Assembly of Head Components

The following procedure is a step-by-step description of the assembly procedure for the head components. The numbers provided in ( ) refer to a specific drawing / part number of each particular part. The numbers noted in { } after the bolt size indicate the size of the hex wrench required to perform that step of the assembly. All bolts should be tightened to the torque specifications provided in Section 2.1.3.

1. Attach the two uniaxial accelerometers (T1INM111) to the Top Bi-axial Accelerometer Mount (T1HDM011) using two #0-80 x 1/8" SHCS {0.050} per sensor as shown in **Figure 4.3**. The orientation of the top head accelerometers is as follows: +X is to the front, +Y is to the right.

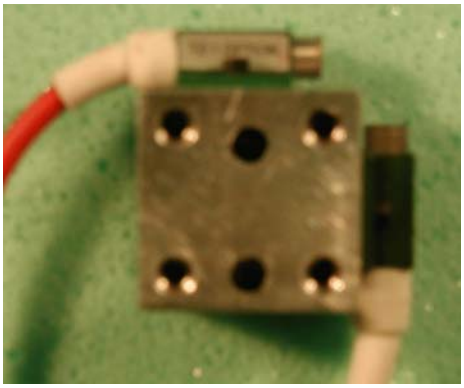

Figure 4.3- Top accelerometers installed

2. Install the Top Bi-axial Accelerometer Mount with accelerometers inside the top surface of the head as shown in **Figure 4.4**. There are two dowel pins inside the head at the top surface of the casting used to locate the mount. Using four #4-40 x 5/16 SHCS {3/32} fastened from the outer-top surface of the head, secure the mount to the head casting.

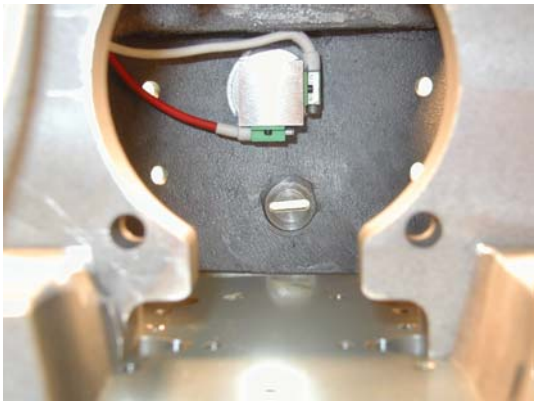

Figure 4.4- Top bi-axial mount installed in the head

3. Attach the 7 Accelerometer Array Fixture (T1HDM212) to the Head Accelerometer Platform (T1HDM210) using four 1/4-28 x 5/8" FHSCS {5/32} as shown in **Figure 4.5**.

4. Attach the seven uniaxial accelerometers (T1INM111) using two #0-80 x 1/8" SHCS {0.050} per sensor to the 7 Accelerometer Array Fixture as shown in **Figure 4.5**. (**Note:** The Z-axis accelerometers are mounted upside down, inside a groove, so that the +Z axis is pointing downward.) The orientation of the accelerometers while the instruments are installed in the dummy is as follows: (**Note:** The front of the Head Accelerometer Platform is considered to be the side with the half circle machined from the plate.)

Side Arm

Side +X = Front
Side +Z = Down

Rear Arm

Rear +Y = Right
Rear +Z = Down

CG

CG +X = Front
CG +Y = Right
CG +Z = Down

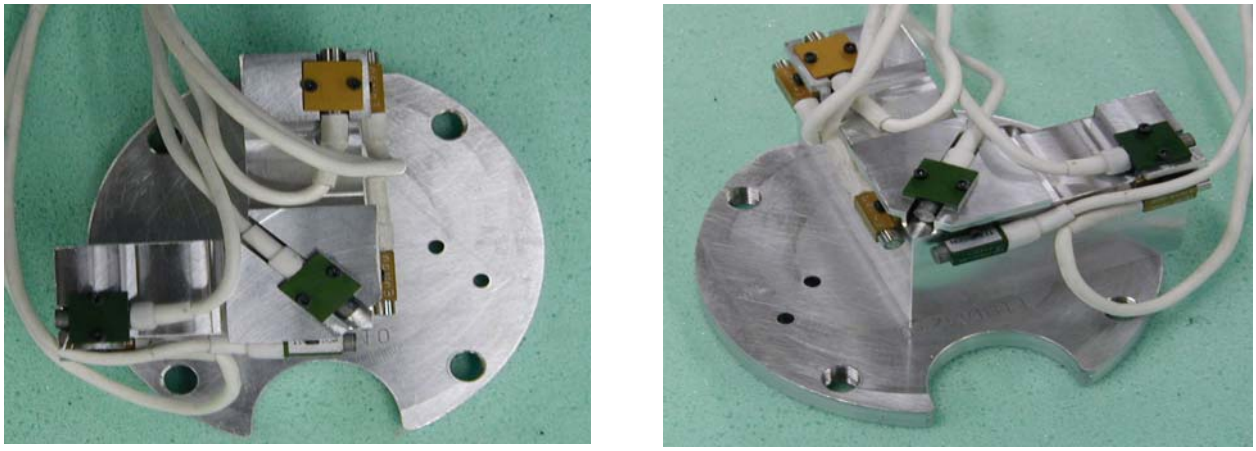

Figure 4.5- Attaching the side, rear, and cg accelerometers

NOTE: The orientation of the head accelerometers corresponds to the SAE dummy coordinate system.

5. Attach the Head Tilt Sensor Housing (T1HDM010) with sensor to the right-side of the Head Accelerometer Platform using two #4-40 x ½" FHSCS {1/16} as shown in **Figure 4.6**. (**Note:** The side of Head Tilt Sensor Housing with the slot is positioned towards the rear of the Head Accelerometer Platform.)

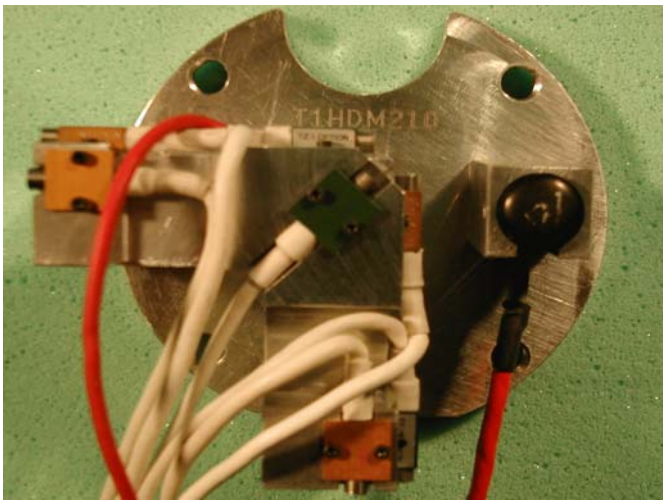

Figure 4.6- Head Tilt Sensor Installed

6. To attach the head to the neck assembly, insert the completed Head / Neck Mounting Platform Assembly (T1NKM200) - See Section 5 - Neck Assembly for further details - up through the bottom of the Head Casting Assembly (T1HDM000). Fasten the Neck Assembly to the Head Casting Assembly using four 1/4-28 x 1" BHSCS {5/32} installed at the bottom of the Head/Neck Mounting Platform Assembly. (These mounting screws are typically inserted through the Head/Neck Mounting Platform Assembly (T1NKM200) prior to assembling the condyle bolt-See Section 5-Neck Assembly for further details.

NOTE: The neck must be oriented so that the front cable and spring are positioned toward the front of the dummy. Refer to the neck section for further details.

7. The instrumentation wires from the head are split into two bundles. The wires from the head accelerometers, front spring load cell, and rear spring load cell are routed out the left-side of the Head Casting. The wires from the tilt sensor and face load cells are routed out the left-side of the Head Casting.

8. Reassemble the Head Skin (T1HDS020) onto the Head Casting if it was removed

in a previous step. Make sure that the 0.20 diameter hole on each side of the Head Skin is aligned with the #4-40 x 1/4" SHCS {3/32} on the each side of the Head Casting. The #4-40 x 1/4 SHCS on the head casting projects the location of Head CG externally along the y-axis of the dummy's head.

9. Position the Head Cap Skin (T1HDS010) onto the Head Cap (T1HDM110). Assemble the head cap assembly onto the rear of the skull by sliding it down into position while routing the wire bundles out through the bottom sides of the cap (Refer to Step 7 for the proper bundling of the instrumentation wires.). The cap is secured in place using four 1/4-20 x 5/8" SHCS {3/16} as shown in **Figure 4.7**.

10. Strain relieve the wire bundles to each side of the Head/Neck Mounting Platform Assembly using a 3/8" wire clamp and a #6-32 x 3/8" BHSCS on each side as shown in **Figure 4.7**. (**Note:** If the wires are slightly loose in the wire clamp, unfasten the clamp, wrap the bundle of wires with electrical or rubberized tape and reinstall.)

Figure 4.7- Head cap with skin bolted to head assembly with head wires strain relieved

11. The head angle is now adjusted as described in Section 4.3.1. After the adjustment is completed, the Head Plug (T1HDM116) is tightened into the front hole in the top of the head casting and the Rear Head Plug (T1HDM117) is installed in the Head Cap (T1HDM110) using two 2-56 x ½ SHCS {5/64} as shown in **Figure 4.8**. The head plugs are used to prevent the front and rear spring assemblies from ejecting from the head in the event of a cable failure.

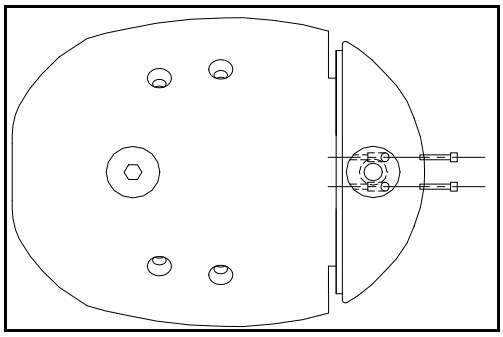

Figure 4.8- Head plugs installed

4.3 Adjusting the Head Assembly

4.3.1 Head Angle Adjustment

The following procedure is a step-by-step description of the procedure for the head angle adjustment. This adjustment procedure is used to set the angle of the head relative to the ground plane. (This is also referred to as the eye level or eye plane adjustment in some literature.) The numbers provided in ( ) refer to a specific drawing / part number of each particular part. The numbers noted in { } after the bolt size indicate the size of the hex wrench required to perform that step of the assembly. All bolts should be tightened to the torque specifications provided in Section 2.1.3- Bolt Torque Values.

1. Remove the Head Plug (T1HDM116) and Rear Head Plug (T1HDM117) if they were previously installed. Place the Neck Spring Adjustment Socket (T1NKT010) through the front spring adjustment access hole until it engages the nut on top of the front neck spring assembly. Place the Neck 3/8" Ratchet Spinner (T1NKT010) on top of the Neck Spring Adjustment Socket. Place a slotted screwdriver {Tip width = 1/8", Blade Length = 4" min.} through the thru hole in the Neck Spring Adjustment Socket and Ratchet so that the slotted screw driver engages the slot at the top of the front spring cable.
2. Hold the slotted screw driver from spinning to lock the neck cable in place while tightening the nut until it engages the top of the front neck spring as shown in **Figure 4.9**. Repeat steps 1 and 2 for the rear spring adjustment. The adjustments to the front and rear neck spring assemblies are made to set the head angle. The head angle will vary depending on the desired test set-up, however, most set-ups require that the eyes be directed straight ahead - parallel to the ground.

NOTE: The proper torque adjustment of the spring adjustment nuts is to remove the slack from the cable systems without precompressing the spring assemblies.

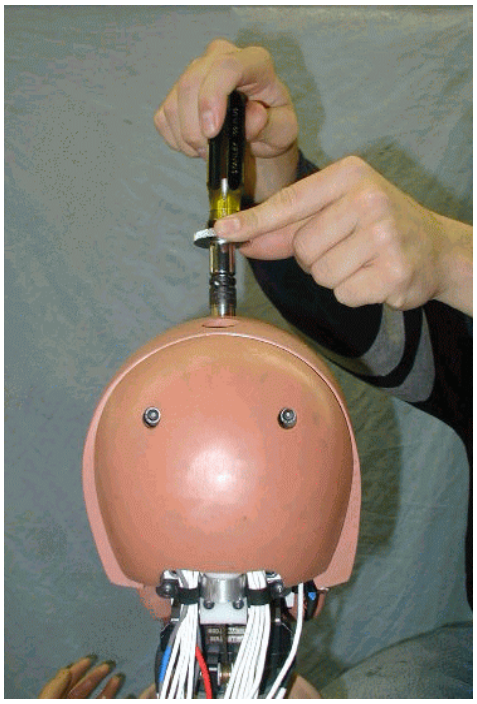

Figure 4.9- Front neck spring adjustment

4.4 Electrical Connections and Requirements

There are two wire loop clamps which provide strain relief for the head instrumentation wires. These two wire loop clamps are attached to the back of the Head /Neck Mounting Platform Assembly (T1NKM200). The wire bundles are split into two groups, one exiting through the holes in the head cap on each side of the rear spring tube assembly. The head accelerometer wires, front spring load cell, and rear spring load cell are bundled and strained relieved to the left-side of the Head/Neck Mounting Platform Assembly (T1NKM200). The face load cell wires, and the tilt sensor wire are bundled and strained relived to the right-side of the Head/Neck Mounting Platform Assembly (T1NKM200) A small amount of slack should be provided between the instruments and the wire clamps to prevent stress on the instruments themselves.

4.5 Head Certification

The head assembly is subjected to a drop test and a pendulum impact test. Certification procedures for this test are described in the THOR Certification Manual - available from the manufacturer as a separate publication.

4.6 Inspection and Repairs

After a test series has been performed, there are several inspections which may be made to ensure that the dummy integrity has remained intact. Good engineering judgement should be used to determine the frequency of these inspections, however the manufacturer recommends a thorough inspection after every twenty tests. The frequency of the inspections should increase if the tests are particularly severe or unusual data signals are being recorded. These inspections include both electrical and mechanical inspections. This inspection is most easily carried out during a disassembly of the dummy. The disassembly of the head components can be performed by simply reversing the procedure used during the assembly.

Although this disassembly is very simple, some comments are provided below to assist in the process.

4.6.1 Electrical Inspections (Instrumentation Check)

This inspection should begin with the visual and tactile inspection of all instrument wires from the head instrumentation. The wires should be inspected for nicks, cuts, pinch points, and damaged electrical connections which would prevent the signals from being transferred properly to the data acquisition system. The instrument wires should be checked to ensure that they are properly strain relieved. A more detailed check on the individual instruments will be covered in Section 15 - Instrumentation and Wiring.

4.6.2 Mechanical Inspection

Several components in the head assembly will need a visual inspection to determine if they are still functioning properly. This mechanical inspection should also involve a quick check for any loose bolts in the main assembly. Each area of mechanical inspection will be covered in detail below. Please contact the manufacturer regarding questions about parts which fail the mechanical inspection.

General: The following checklist should be used when inspecting the head instrumentation for post-test damage:

- Check the tightness of all instrumentation mounting bolts

Head Adjustments: The following checklist should be used when inspecting the head angle during the post-test inspection:

- Check the head angle adjustment as described in Section 4.3.1- Head Angle Adjustment

Head Skin: The following checklist should be used when inspecting the head skin for post-test damage:

- Check the head skin for tears and damage.